CHANGE OF STATUS FOR *PHYSOSTEGIA VIRGINIANA* VAR. *LEDINGHAMII* (LABIATAE) AND EVIDENCE FOR A HYBRID ORIGIN

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Physostegia virginiana (L.) Benth. and *P. parviflora* Nutt. ex Gray have long been known from central Canada. The existence in the region of a third taxon intermediate between these two was noted by Boivin (1966), who recognized it as var. *ledinghamii* of *P. virginiana*. The taxon was earlier treated as a distinct species (Fraser & Russell, 1953), but the name has never been validly published at that rank. I am now raising the taxon to the species level on the basis of evidence that it is a tetraploid derivative of a hybrid between *P. parviflora* and *P. virginiana*.

Physostegia ledinghamii (Boivin) Cantino, *comb. et stat. nov.*

Physostegia ledinghamii Boivin ex Fraser & Russell, Annot. List Pl. Sask. 36. 1953. Nom. nud.

Physostegia virginiana var. *ledinghamii* Boivin, Nat. Canad. **93:** 574. 1966. HOLOTYPE: Saskatchewan, Swift Current District, Cabri, "15 milles au nord, platière sablonneuse de la Saskatchewan du Sud," 28-VII-1952, *Boivin & Alex 9978* (DAO).

Representative specimens. CANADA. **Alberta:** Fort Saskatchewan, *Turner 4979* (ALTA); Manola, 26-VII-1968, *Rusconi s.n.* (ALTA); Clyde, *McCalla E2692* (ALTA). **Manitoba:** Le Pas, 21-VII-1936, *Howe s.n.* (DAO, TRT, SCS). **Northwest Territories:** Salt River, *Loan 137* (DAO, ALTA, MO). **Saskatchewan:** Tisdale, *Breitung 1790* (DAO, ALTA, SMU); North Battleford, *Frankton 945* (DAO); Green Lake Village, *Harms 16792* (DAO, GH). UNITED STATES. **North Dakota:** Burleigh Co., Bismarck, *Metcalf 388* (US); McLean Co., Ft. Berthold Indian Res., *Heidenreich 210* (OKL).

The distributions of *Physostegia ledinghamii*, *P. parviflora*, and *P. virginiana* approach one another in North Dakota, southeastern Saskatchewan, and southwestern Manitoba (Figure 1). They have not been recorded from the same site but they grow in similar habitats along the edges of rivers, lakes, and ditches and could be expected to occur together at least occasionally in the region where their ranges come into contact.

The principal morphological distinctions among the three species

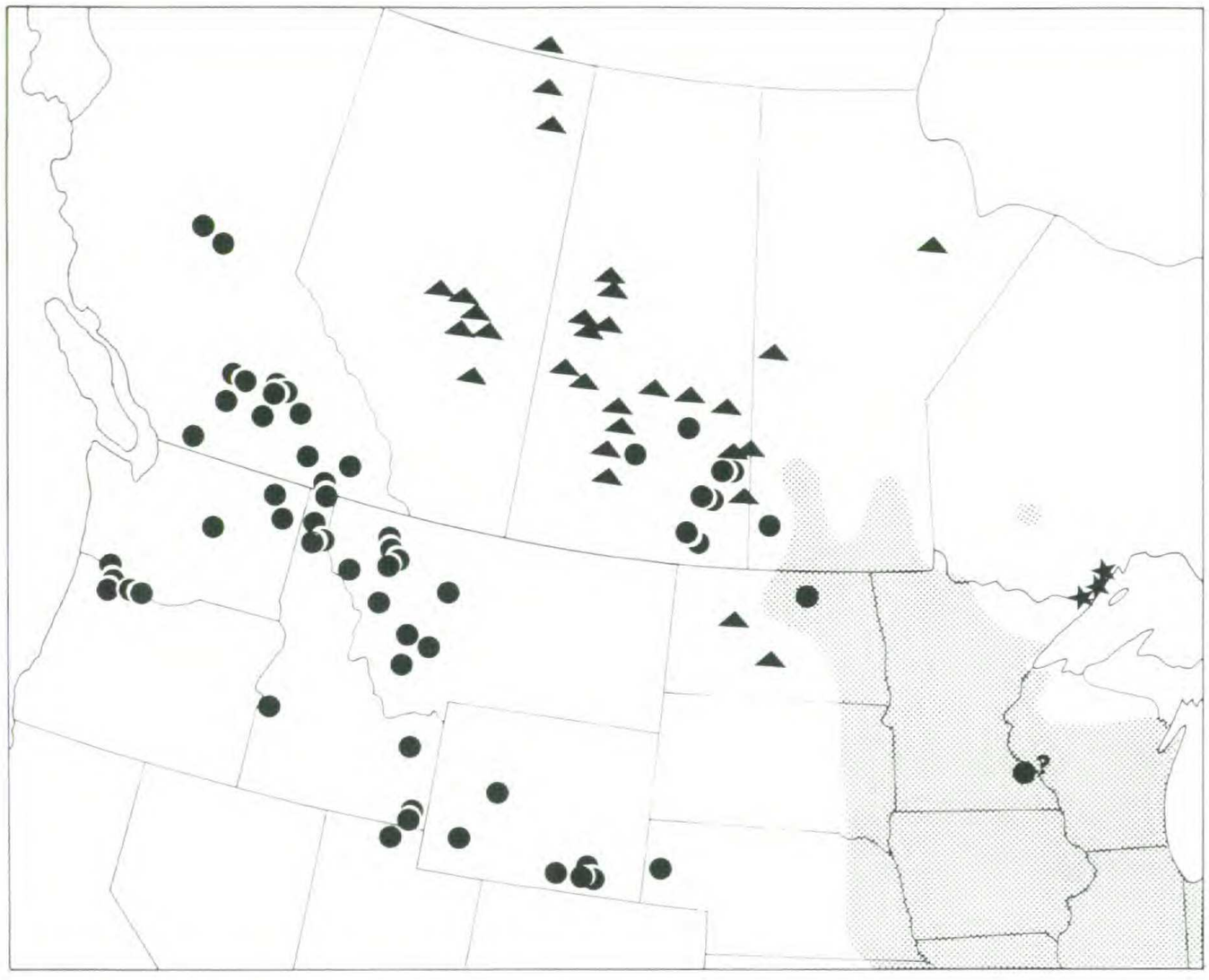

Figure 1. Distribution map of *Physostegia parviflora* (circles) and *P. ledinghamii* (triangles). The shaded area represents the northwesternmost portion of the range of *P. virginiana*. The stars represent specimens of uncertain affinities (see text). The question mark indicates a questionable record of *P. parviflora* (a single specimen with possibly incorrect locality data).

are summarized in Table 1. The percentages listed refer to the approximate percentage of the available herbarium specimens on which a given character state was found. The sample size varied by species and by character, but at least 30 specimens of each species were examined for every character except nutlet length. For the latter character, nutlets from at least 10 collections of each species were measured. The character states tabulated for *Physostegia virginiana* refer not to that species in its entirety, but only to the portion of its distribution that approaches the ranges of *P. parviflora* and *P. ledinghamii*—i.e., *P. virginiana* from Manitoba, western Ontario, the Dakotas, Minnesota, and northern Wisconsin. *Physostegia ledinghamii* resembles *P. parviflora* in one character (No. 1), *P. virginiana* in two characters (Nos. 3&8), and is intermediate between these two species in three characters (Nos. 2,6,&7). There are two size characters (Nos. 4&5) in which *P. ledinghamii* exceeds both *P. parviflora* and *P. virginiana* to some degree.

Table 1. **Distinguishing Characteristics of Physostegia parviflora, P. ledinghamii, and P. virginiana**

Characters	*P. parviflora*	*P. ledinghamii*	*P. virginiana*
1. Upper leaves clasp stem	always	always	no>95%
2. Stalked glands present on corolla	yes>90%	yes≈30%	no>95%
3. Length of flowers (on dried specimens)	(9–)11–16 mm	14–23 mm	14–23 mm
4. Length of longest nonglandular trichome on axis of raceme	.075–.15 mm	.14–.225 mm	.075–.15 (–.20) mm
5. Length of nutlets	2.1–3.3 mm	2.8–4.0 mm	2.5–3.2 mm
6. Some of the upper leaves are widest near base of blade	yes>95%	yes≈40%	no>95%
7. Upper leaves have one to three pairs of weak primary veins arising from base of blade	yes≈90%	no≈80%	no>95%
8. The majority of the stem leaves are bluntly toothed to entire	yes≈30%	never	never

Although there is overlap between *Physostegia ledinghamii* and *P. parviflora* in every character listed in Table 1, the two species are easily distinguished if the characters are used in combination. When

the principal diagnostic characters are plotted on a scatter diagram (Figure 2), two clusters are apparent, connected by a small zone of overlap. Specimens represented by points within this zone of overlap have been identified to species on the basis of foliar characters listed in Table 1. It is significant that individuals of either species that exhibit a morphology approaching that of the other are no more frequent within the region of sympatry than outside of it. Of the five data points included in the zone of morphological overlap in Figure 2, only two of them represent specimens collected in the region of sympatry. Thus it would appear unlikely that the existence of morphologically intermediate individuals is due primarily to hybridization between *P. parviflora* and *P. ledinghamii.* Hybridization may be occurring occasionally, but if it were a common occurrence, the frequency of individuals with an intermediate morphology would be far greater within the region of sympatry than outside of it.

The apparent absence of extensive hybridization between *Physostegia parviflora* and *P. ledinghamii,* in spite of their partial sympatry and lack of any obvious ecological or temporal isolating mechanism, when considered with the intermediate morphology and geographic location of the latter, led me to suspect that *P. ledinghamii* might be a tetraploid hybrid derivative of *P. parviflora* and *P. virginiana*. The tetraploid nature of *P. ledinghamii* has been confirmed by cytological study of plants collected 8 miles south of Saskatoon, Saskatchewan (*V. L. Harms 27623*; voucher, GH). Using root tips pretreated in 8-hydroxyquinoline (procedure outlined by B. W. Smith in Radford, et al., 1974, pp. 251–252; originally adapted from Tijo & Levan, 1950), I obtained three counts of 2n=76 for *P. ledinghamii.* A photograph can be found in my doctoral thesis (1980) and will be published at a later date as part of a monograph of the genus. Both *P. parviflora* and *P. virginiana* have 19 pairs of chromosomes (Taylor & Brockman, 1966; Fedorov, 1969; Cantino, 1980).

The conclusion that *Physostegia ledinghamii* in its entirety is tetraploid must remain tentative, inasmuch as it is based on the chromosome number of a few members of a single population. However, when it is considered in conjunction with the morphological and geographical intermediacy of *P. ledinghamii*, this single tetraploid count lends support to the hypothesis of a hybrid origin for the species.

There are two characters in which *Physostegia ledinghamii* resembles neither of its putative parents. It has larger nutlets, and the

trichomes in the inflorescence average slightly longer than those of *P. parviflora* or *P. virginiana* (Table 1). The higher ploidal level of *P. ledinghamii* may be responsible for the increased size of both structures. It is well known that polyploidy frequently results in an increase in cell size, and Stebbins (1950) mentions "few-seeded fruits" as one of the kinds of organs in which "gigas effects" of polyploidy are most likely to be seen. The trichomes of *Physostegia,* being simple structures consisting of very few cells, may be similarly prone to an increase in overall length due to an increase in the size of the component cells. It has been observed in *Matthiola incana* that colchicine-induced polyploid branches have larger trichomes than do diploid branches on the same plant (Emsweller & Ruttle, 1941).

Using a strictly phenetic species definition, one could argue that the degree of morphological distinction between *Physostegia ledinghamii* and *P. virginiana* is not sufficient to warrant recognition of the former at the species level. However, if my hypothesis about its origin is correct and its gene pool includes a substantial contribution from *P. parviflora,* it would seem more justifiable to treat it as an independent entity rather than grouping it with one of its parents. Such an approach is more justifiable from the standpoint of a "biological" species concept as well, inasmuch as the higher ploidal level of *P. ledinghamii* necessarily isolates it, at least to a degree, from *P. virginiana* and *P. parviflora.*

Although justifiable on evolutionary grounds, the recognition of *Physostegia ledinghamii* at the species level creates a practical problem in that it is distinguishable from *P. virginiana* and *P. parviflora* on the basis of relatively few morphological characters, none of them absolutely reliable. The limited morphological basis for distinguishing these species leaves in question the affinities of a group of specimens collected near Thunder Bay, Ontario (*Garton 1958,* NY, GH, TRT, DAO; *Garton 5733,* DAO; *Cormack & Mayall s.n.,* 15-VIII-1936, TRT, MICH; *Allin s.n.,* 16-VIII-1964, TRT). Most of the specimens have at least a few leaves that clasp the stem to some degree, although the NY specimen of *Garton 1958* does not. The trichomes on the axis of the inflorescence do not exceed 0.1 mm in some specimens but reach 0.15 mm in others. Thus some plants fall within the morphological limits of *P. ledinghamii* and others do not. Because these specimens (represented by stars in Figure 1) were collected more than 500 miles east of the otherwise known range of *P. ledinghamii,* but only about 100 miles from areas in northeastern

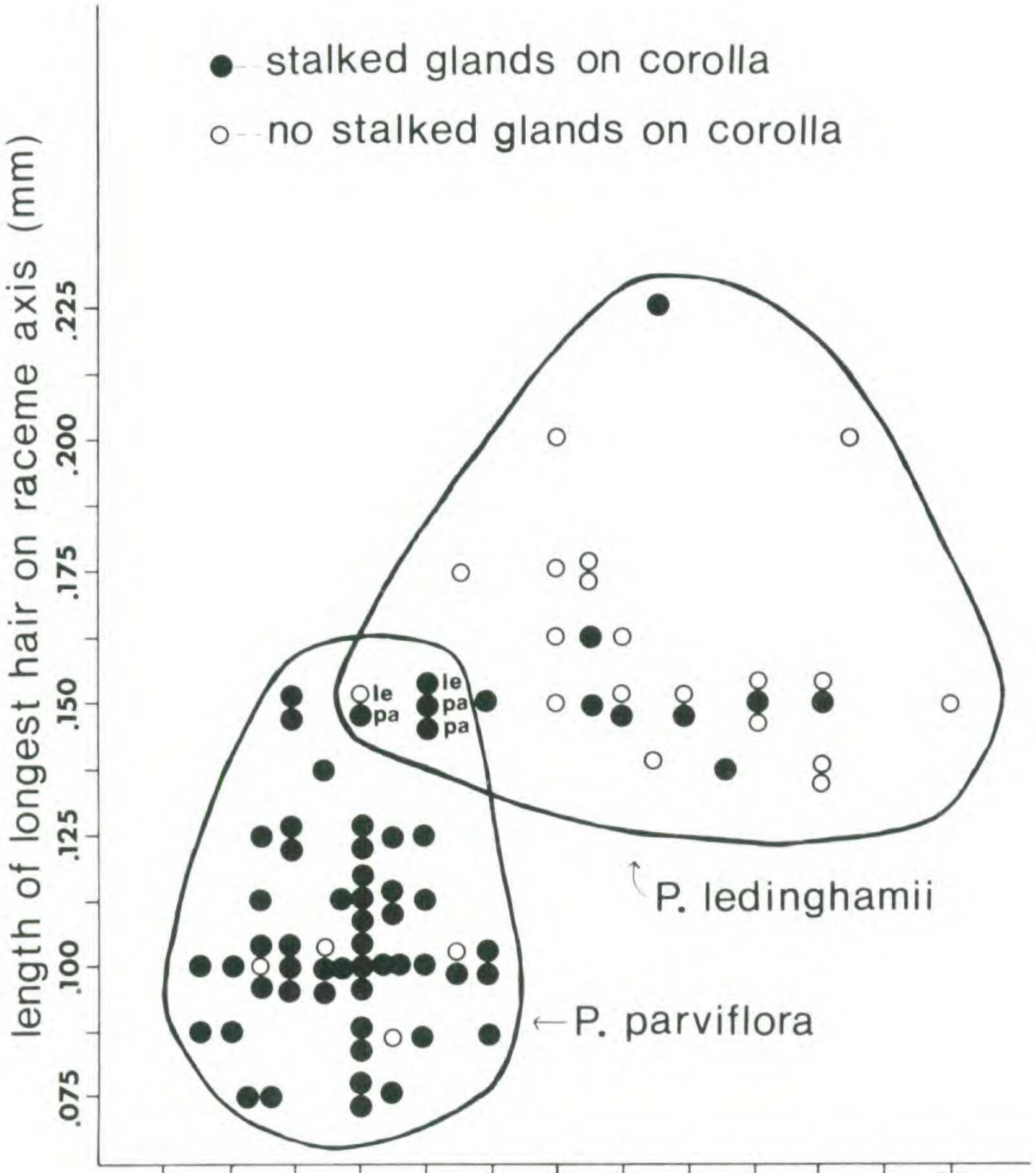

Figure 2. Graph of flower length vs. length of the longest nonglandular trichome on the raceme axis in *Physostegia parviflora* and *P. ledinghamii*. Each symbol represents a single herbarium specimen. In the zone of interspecific overlap, symbols labeled "le" represent *P. ledinghamii* and those labeled "pa" represent *P. parviflora*.

Minnesota where *P. virginiana* abounds, I suspect that they represent a form of the latter in which a clasping leaf base like that of *P. ledinghamii* has evolved in parallel. Clasping leaves are very rare in *P. virginiana* but are present on a few specimens collected from one locality in Ohio and one in North Carolina.

This hypothesis is lent some support by measurements of nutlet length. Few of the Thunder Bay specimens include nutlets, but those examined were 2.5–2.8 mm long, a length that is consistent with the range of variation in *Physostegia virginiana* but outside the known limits for *P. ledinghamii* (Table 1). As an alternative hypothesis, it is possible that the Thunder Bay plants represent a disjunct segment of the distribution of *P. ledinghamii,* which originated through long-distance dispersal or possibly by means of a second incident of hybridization between *P. parviflora* and *P. virginiana. P. parviflora* is not presently found anywhere near Thunder Bay, however. A few chromosome counts would do much to illuminate the situation. In the meantime, the bulk of the evidence supports a tentative assignment of the problematical specimens to *P. virginiana.*

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